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Marine Physical Laboratory

Processing and Analysis of SeaMARC II Data: (1) Fieberling Guyot; (2) Raw Phase Experiment in Norwegian-Greenland Sea

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Final Report to the
Office of Naval Research
for Grant N00014-91-J-1073
for the Period 10-01-90 - 09-30-92

MPL-U-16/93
April 1993

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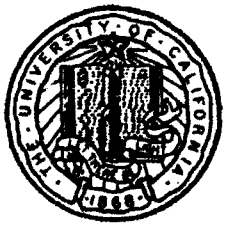

University of California, San Diego
Scripps Institution of Oceanography

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. Agency Use Only (Leave Blank).	2. Report Date. April 1993	3. Report Type and Dates Covered. Summary

4. Title and Subtitle.
Processing and Analyses of SeaMARC II Data: (1) Fieberling Guyot; (2) Raw Phase Experiment in Norwegian-Greenland Sea

5. Funding Numbers.
N00014-91-J-1073

6. Author(s).
C. de Moustier and P. F. Lonsdale

Project No.
Task No.

7. Performing Monitoring Agency Names(s) and Address(es).
University of California, San Diego
Marine Physical Laboratory
Scripps Institution of Oceanography
San Diego, California 92152

8. Performing Organization Report Number.
MPL-U-16/93

9. Sponsoring/Monitoring Agency Name(s) and Address(es).
Office of Naval Research
Department of the Navy
800 North Quincy Street
Arlington, VA 22217-5000
Code 1125OA

10. Sponsoring/Monitoring Agency Report Number.

11. Supplementary Notes.

12a. Distribution/Availability Statement.
Approved for public release; distribution is unlimited.

12b. Distribution Code.

13. Abstract (Maximum 200 words).

The objectives of this work were to devise processing techniques for acoustic measurements made with bathymetric sidescan sonar systems and to apply them to data collected with the SeaMARC II system. The main goals were to provide end-users with co-registered acoustic imagery and bathymetry displayed in a geographic reference frame with a minimum of artifacts and with improved contrast or feature definition, while retaining as much as possible the relative acoustic backscatter contrast due to the geology of the area.

14. Subject Terms.
seafloor bathymetry data, Sea Beam

15. Number of Pages.
2

16. Price Code.

17. Security Classification of Report.	18. Security Classification of This Page.	19. Security Classification of Abstract.	20. Limitation of Abstract.
Unclassified	Unclassified	Unclassified	None

MPL-U-16/93

PROCESSING AND ANALYSES OF SEAMARC II DATA: (1) Fieberling Guyot; (2) Raw Phase Experiment in Norwegian-Greenland Sea

C. de Moustier, P. Cervenka and P.F. Lonsdale

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Long-Term Scientific Objective

To establish efficient and accurate signal processing techniques for seafloor remote sensing operations aimed at characterizing the bottom by acoustic methods.

Project Objectives

The objectives of this work were to devise processing techniques for acoustic measurements made with bathymetric sidescan sonar systems and to apply them to data collected with the SeaMARC II system. The main goals were to provide end-users with co-registered acoustic imagery and bathymetry displayed in a geographic reference frame with a minimum of artifacts and with improved contrast or feature definition, while retaining as much as possible the relative acoustic backscatter contrast due to the geology of the area.

Research Results

The primary data set for this work came from a combined SeaMARC II, Sea Beam survey of Fieberling Guyot, conducted in 1989. The nearly complete (90%) coverage of the guyot with Sea Beam swath bathymetry provided a convenient reference to quantify the results of the processing methodology applied to the SeaMARC II data.

The first order of processing involved reducing the noise content of the bathymetry and imagery data using spatial filtering techniques that take into account the acoustic and

geometric characteristics of the sonar system. Artifacts that were clearly unrelated to the acoustic backscattering properties of the seafloor were isolated on a ping by ping basis through a spectral decomposition, using Chebyshev polynomials, to filter the low spatial frequency components of the image. In addition, a stochastic approach was implemented to deal with systematic across-track biases imparted by the real-time conversion from electrical phase angle to acoustic angle that is based on an empirical table established for a flat bottom at a given depth.

Because bathymetry and sidescanned acoustic imagery had been treated as two separate processes at the time the data were acquired, and because a flat bottom assumption was used to display the imagery, it was necessary to register the acoustic images with the bathymetry. This was done using a pixel relocation process based on a representation of the seafloor as viewed by the sonar system. This process identifies ambiguous areas to be avoided and, depending on the relative geometry of the transformed topography, it remaps pixels in the (x,z) plane or in the (x,s) plane. x represents across-track horizontal distances, z represents depths and s slant ranges.

With co-registered bathymetry and sidescanned imagery, the two sets of data can be mapped on a geographic grid and displayed as matching plane representations of the seafloor at various projections, or overlaid and presented in pseudo-3D perspective to help highlight specific relief features. In the transfer of pixels to a geographic grid, due account was taken of the geometry of the measurement and of the spacing between pings to minimize along-track smearing. To enhance the contrast of the mosaic of sidescanned swaths for the whole survey, a modified histogram equalization technique was implemented that balances local versus global histogram contributions, while preserving the relative acoustic backscatter contrast of the image due to the geology.

This project has been completed and results have been reported in several manuscripts, listed below, that have been submitted for publication.

Publications Supported by ONR

Masnadi-Shirazi, M.A., de Moustier, C., Cervenka, P. and Zisk S.H., 1992, Differential phase estimation with the SeaMARC II bathymetric sidescan sonar system, IEEE J. Oceanic Engineering, 17(3), 239-251, 1992.

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Cervenka, P. and de Moustier, C., and Lonsdale, P., 1991. Post processing of SeaMARC II bathymetry data, EOS, Trans., Am. Geophys. Union, 72(44) 249.

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Cervenka, P. and de Moustier, C., (submitted), Sidescan sonar image processing techniques, IEEE J. Oceanic Engineering

Cervenka, P., de Moustier, C., Lonsdale, P. F., (in preparation), Correction of sidescan sonar images based on bathymetry: application with SeaMARC II and Sea Beam, J. Geophys. Res.

Cervenka, P. and de Moustier, C., (submitted), Post-processing of bathymetry derived from sidescan sonar systems, IEEE J. Oceanic Engineering.

ONR/MPL REPORT DISTRIBUTION

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